
Chapter 1 — ISDN Basic Rate Interface

Introduction

This chapter gives an overview of Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI).

Note: This document is intended to support the Meridian 1 Option 11 (sometimes referred to simply as the Option 11) system. (When only the term “Meridian 1” is referenced, it is meant to include all members of the Meridian 1 family (Meridian 1 Option 11 through Option 81C).

ISDN Overview

Integrated Services Digital Network (ISDN) is a global networking strategy that provides an intelligent, universal network for voice and data communications. ISDN is a set of international standards that define the next generation of digital networking services.

Some of the benefits of ISDN are as follows:

- faster, more accurate, noise-free transmission, as well as greater security and reliability
- ability to carry multiple information types, including speech, data, image, and video
- standard interfaces to allow multi-vendor compatibility
- configuration flexibility when combining public and private networking facilities.

ISDN differs from traditional communication in that it uses “out of band” signaling. Signaling information is sent and received on a dedicated channel, called a D-channel, leaving the remaining channels, called B-channels, free for voice and data.

Option 11 provides the following ISDN accesses:

- Primary Rate Interface (PRI)
 - 1.5 Mb T1 (23B+D)
 - 2.0 Mb E1 (30B+D)
- Basic Rate Interface (BRI)
 - A single digital access connection

This document focuses on Basic Rate Interface for the Option 11. For more information on PRI refer to 553-3011-310, *1.5 Mb DTI/PRI Administration and Maintenance guide* and 553-3011-315, *2 Mb DTI/PRI Administration and Maintenance guide*.

ISDN Basic Rate Interface

ISDN Basic Rate Interface (BRI) is a digital connection that provides three digital channels. These channels consist of two 64 kbps Bearer channels (B-channels) and one 16 kbps Data channel (D-channel). This 2B+D connection is known as a Digital Subscriber Loop (DSL) on the Option 11.

The DSL can be configured for the following functionalities:

Line Access - As a line ISDN BRI provides a digital connection from the Option 11 BRI card to an ISDN terminal that comply with CCITT, ANSI, ETSI NET-3, INS NET-64, National ISDN, EuroISDN, 1TR6, Numeris VN2, D70, and Asia-Pacific standards (Numeris is the French ISDN signaling protocol; 1TR6 is the German ISDN signaling protocol; and D70 is the Japanese ISDN signaling protocol). Examples of terminals are: telephone sets, FAX machines, personal computers and video display terminals.

Trunk Access - The trunk access application provides CO/DID connections to local exchanges that support Numeris VN2, 1TR6, D70, EuroISDN, and Asia-Pacific protocols. This application also provides ISDN BRI TIE trunk connectivity, and QSIG ISDN BRI trunk connectivity.

Note: ISDN BRI local exchange connectivity is not supported in North America.

Packet Data transmission - The Option 11 supports both B-channel and D-channel packet data transmission through an external DPN-100 packet handler.

ISDN BRI allows simultaneous voice, circuit-switched data, and packet data transmission over a single DSL.

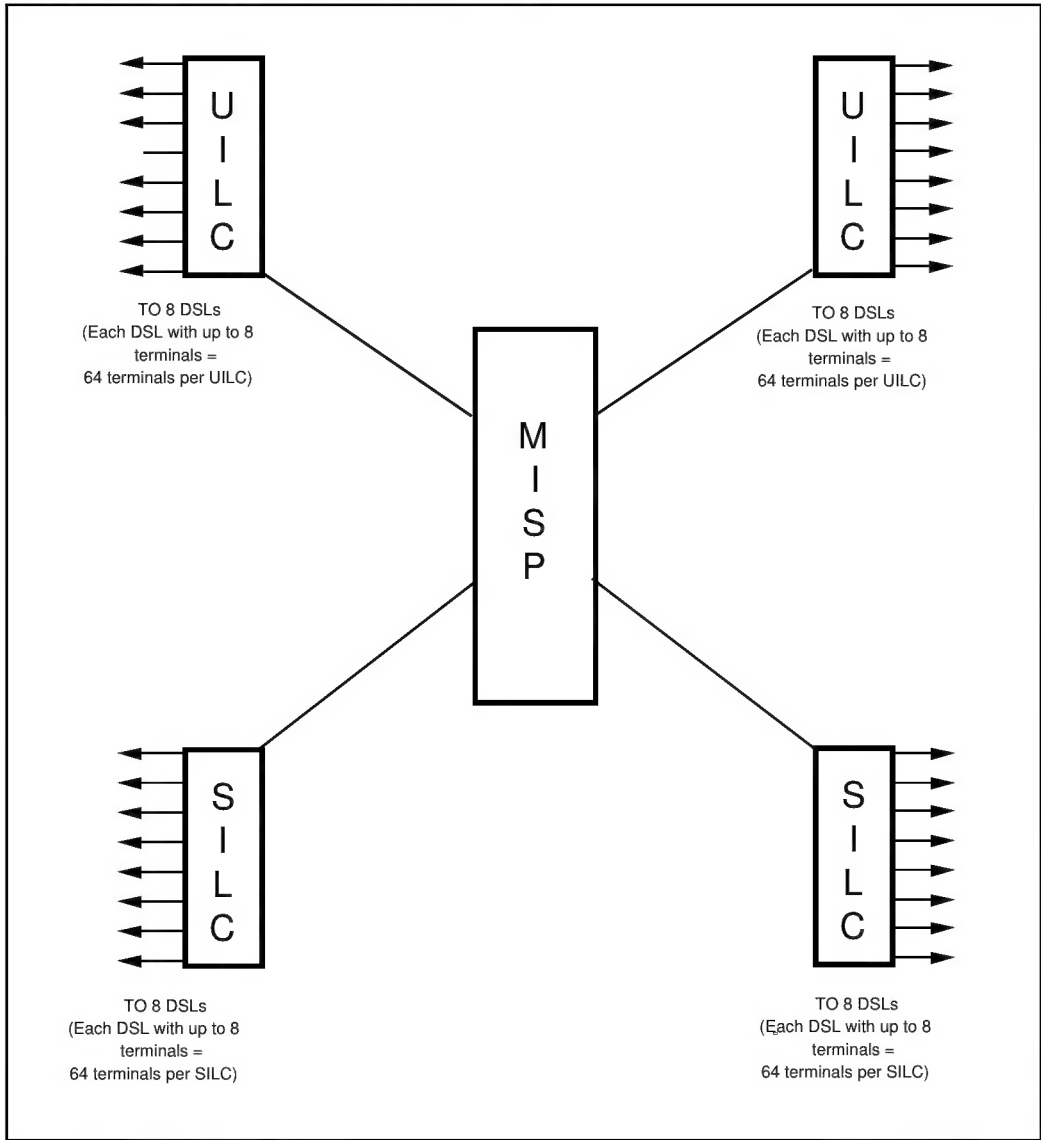
ISDN BRI provides two interface types to the Option 11:

- **S/T interface**, that provides a 4-wire multi-point connection. This interface is provided by an NT6D70 SILC line card, which supports eight DSLs.
- **U interface**, that provides a 2-wire point-to-point connection that uses 2B1Q line encoding. This interface is provided by an NT6D71 UILC line card, which supports eight DSLs.

The following BRI functions are carried out by the **NTBK22 Multi-Purpose ISDN Signaling Processor (MISP)** card on the Option 11:

- Each MISP can support up to four line cards (UILC or SILC or any combination of the two). See Figure 1.
- The MISP executes Open System Interconnect (OSI) link and network layer protocol. Refer to *ISDN BRI protocol* in this chapter for further information.
- The MISP processes the signaling information received on the D-Channels from DSLs. D-Channels may also carry user packet data, which the MISP separates from signaling information and forwards to the external DPN-100 packet handler.
- control terminal initialization and addressing
- assign B-channels for switched voice and data transmission
- send call control messages to ISDN BRI terminals over the D-channel
- supports a clock controller daughter board for BRI trunking applications

Figure 1
ISDN BRI standard maximum configuration



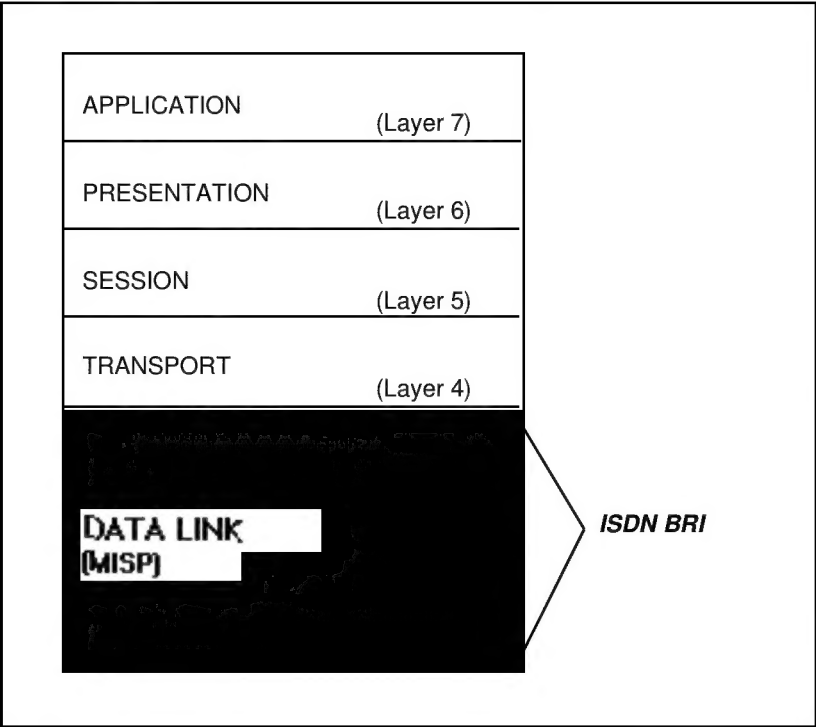
ISDN BRI protocol

ISDN standards have adopted the Open System Interconnect (OSI) protocol model to control ISDN functions. The OSI model defines seven layers required to perform all ISDN functions from establishing an end-to-end physical connection between two terminals to making a decision about the type of application that is to be activated. Figure 2 shows the seven layer OSI model. ISDN BRI hardware utilizes only the first three layers. These are:

- **Physical layer** (layer 1) that provides network-to-terminal physical connections.
- **Data link layer** (layer 2) that provides point-to-point signaling used to establish a communication link between a terminal and its supporting BRI interface card. It also performs error checking and error recovery.
- **Network layer** (layer 3) that controls terminal initialization procedures and assigns service attributes to terminals. It also controls the call set up and disconnect procedures.

Once these three layers are established, the functional role of ISDN BRI hardware in the OSI protocol sequence is complete. The higher layers of the OSI protocol are handled by the system central processing unit (CPU) and the system operating software.

Figure 2
OSI model



ISDN BRI line access

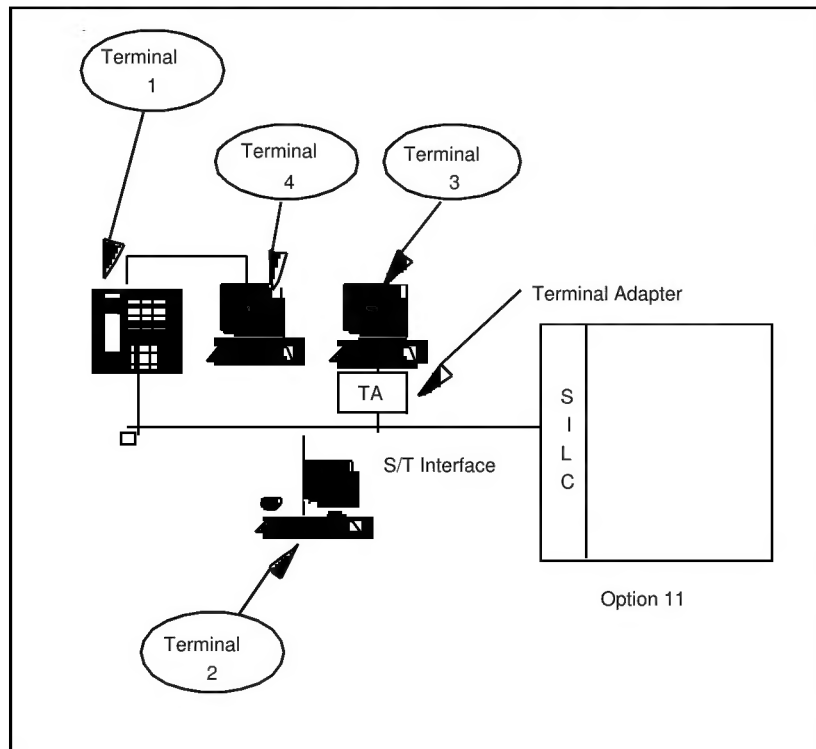
ISDN BRI line access provides 2B+D ISDN service to terminating equipment such as ISDN telephone sets and data terminals. ISDN BRI line connections are configured on a per DSL basis, that is, DSL line connections may be configured on any given DSL for any SILC or UILC.

The B-channels are automatically assigned to different voice and data terminals in circuit-switched line applications. The D-channel is permanently dedicated to a DSL and is used for signaling.

S/T interface

Figure 3 illustrates a typical ISDN BRI configuration showing an Option 11 with an ISDN BRI S/T interface and the terminals connected to it. ISDN BRI terminals that comply with CCITT, ANSI (T.607), ETSI NET-3, INS NET-64, National ISDN, EuroISDN, 1TR6, Numeris VN2, D70, and Asia-Pacific standards can be connected as shown in Figure 3.

Figure 3
ISDN Basic Rate Interface S/T interface configured as a line



The S/T interface permits 4-wire multi-point connection of up to eight physical voice and data terminals on one DSL. A physical terminal is any terminal device directly connected to a DSL. The terminals labeled 1, 2 and 3 in Figure 3 are physical terminals. Each S/T interface supports a maximum of eight physical connections and up to 20 logical terminals on one DSL. A logical terminal is any terminal that can communicate with the Option 11 over a DSL. It may be directly connected to the DSL through its own physical connection (physical terminal) or it may be indirectly connected through a common physical termination. Terminal 4 in Figure 3 is a logical terminal only, while terminals 1, 2 and 3 are physical terminals but are also logical terminals. Multiple logical terminals on a physical termination may, for example, be a combination voice and data terminal.

Each S/T interface provides two B-channels and one D-channel. All the logical terminals connected to the DSL share the two B-channels.

The length of an S/T interface DSL depends on the specific terminal configuration and the DSL wire gauge, however, it should not exceed 1 km (3280 ft). Refer to Chapter 5 for more information.

Terminal Adapters (TAs), as shown in Figure 3, are used to adapt non-BRI terminals to ISDN BRI line interface standards.

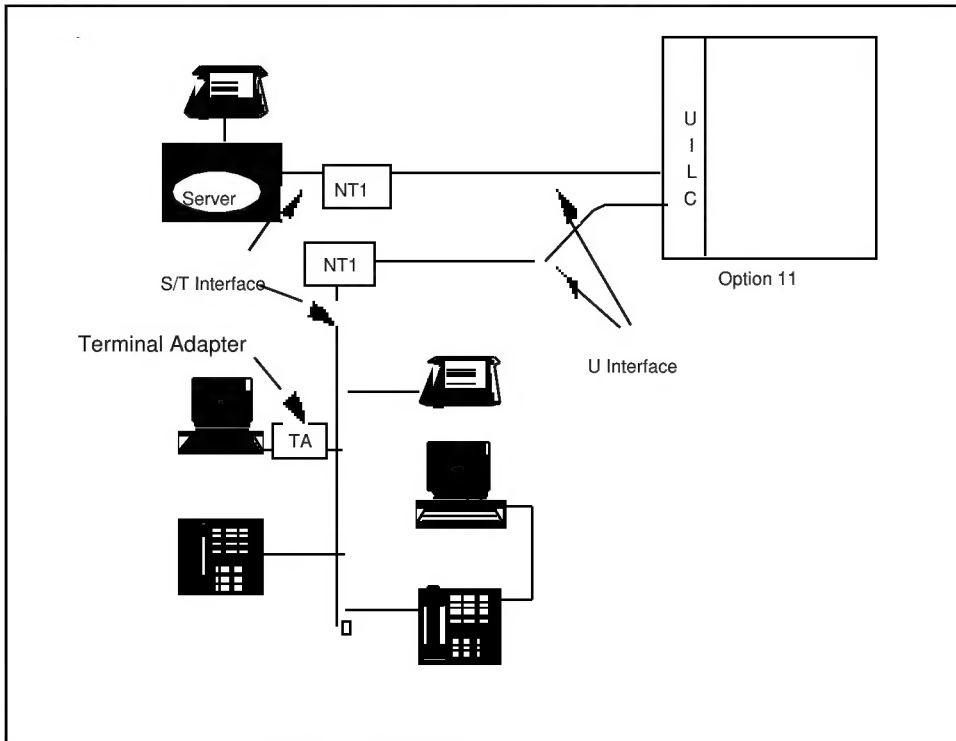
U interface

The U interface provides 2-wire point-to-point connection over a DSL. Each U interface provides two B-channels and one D-channel and supports only one physical termination. This termination may be to a Network Termination 1 (NT1) or directly to a single U interface terminal that contains an internal NT1. Normally this physical termination is to an **NT1**, (that supports 2B1Q line encoding) which provides a conversion from a U interface to an S/T interface that allows up to eight physical terminals to be connected.

The length of a U interface DSL depends on the specific terminal configuration and the DSL wire gauge, however, it should not exceed 5 km (16405 ft). When connected to an NT1 the DSL length is effectively extended to 6 km (19685 ft) and utilizes the multi-terminal capability of an S/T interface.

Figure 4 illustrates a typical ISDN BRI configuration showing an Option 11 with an ISDN BRI U interface. ISDN BRI terminals that comply with NT1 interface requirements can be connected as shown in this diagram.

Figure 4
ISDN Basic Rate Interface U interface configured as a line



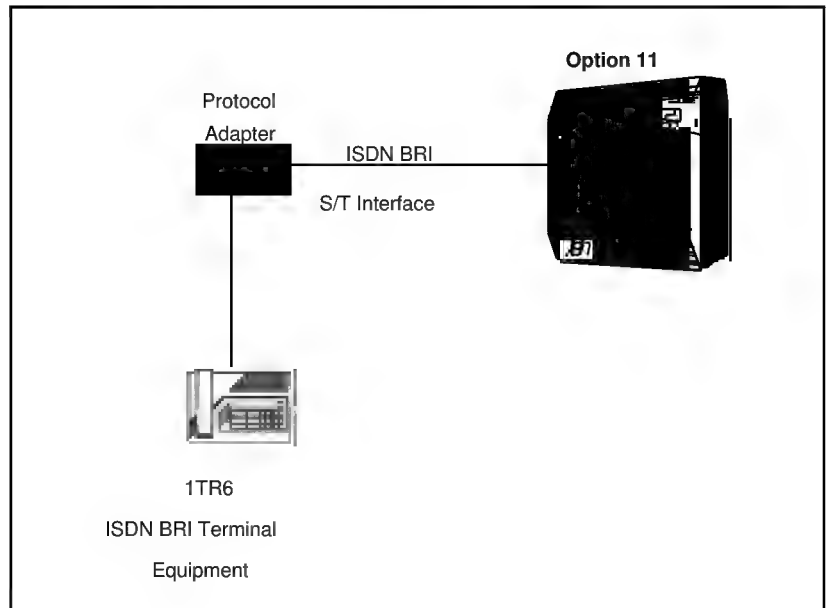
1TR6 terminal connectivity

1TR6 is the ISDN protocol used in Germany and in any country that supports this German protocol.

A protocol adapter has been specifically designed to interface with Option 11 ISDN BRI and 1TR6 terminals. Its main function is to convert 1TR6 protocol, sent from the 1TR6 ISDN Terminal Equipment, into the European Telecommunication Standard Institute (ETSI) protocol required for ISDN BRI, and vice versa. This conversion is necessary because the layer 3 requirements for 1TR6 and ETSI are different.

Figure 5 shows a 1TR6 ISDN BRI terminal connected to a 1TR6 protocol adapter, which is used to access the Option 11. For specific 1TR6 configuration guidelines refer to Chapter 5 (for line applications) and Chapter 6 (for trunk applications).

Figure 5
ISDN BRI/1TR6 terminal connectivity



ISDN BRI Packet Data Transmission

Packet switching differs from circuit switching in that the content of the call is switched rather than the call itself. The message that is being transmitted is broken down into packets that are then sent to their destination through the fastest route.

The Option 11 supports both B-channel and D-channel packet data transmission.

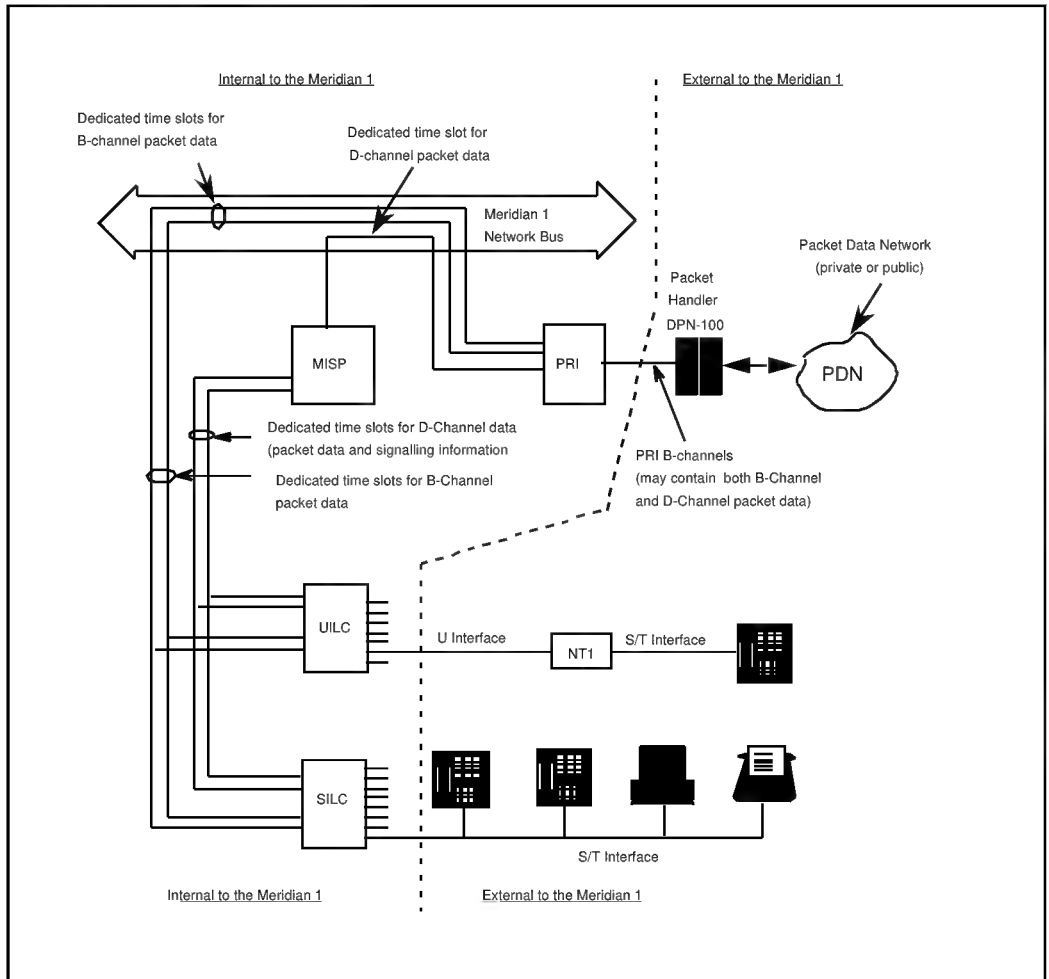
B-Channel packet data transmission - Data is transmitted over dedicated connections (configured in the data base for packet data transmission) from the SILC or UILC line card to a PRI card, and then over PRI B-Channels to an external packet data handler (DPN-100).

D-Channel packet data transmission - D-Channels can be used for both signaling and packet data transmission. Packet data and signaling information is transmitted over dedicated connections from the UILC or SILC line card to the MISP where the signaling information is separated from the packet data. The data is then transmitted over dedicated connections to a PRI card, and then over PRI B-Channels to an external packet data handler (DPN-100).

Northern Telecom's Data Packet Network (DPN-100) is used as an external packet handler to process the D-channel packet data sent by the MISP over a dedicated PRI B-channel, and the B-channel packet data sent from SILCs and UILCs.

Figure 6 illustrates the Option 11 packet data flow diagram showing the B-channel and the D-channel packet data routes starting at the SILC and UILC line cards and arriving at the external packet handler through dedicated connections and PRI B-channels.

Figure 6
Packet handling flow diagram



ISDN BRI trunk access

ISDN BRI trunk connections are configured on a per DSL basis, that is, DSL trunk connections may be configured on any given DSL for any SILC or UILC. The trunks can be accessed by both BRI and non-BRI terminals (such as digital and 500/2500-type telephones).

ISDN BRI trunk access supports Local Exchange CO/DID connectivity, ISDN BRI TIE trunk connectivity, and QSIG ISDN BRI trunk connectivity.

Local exchange CO/DID connectivity is accomplished through a MISP card and an S/T interface, using the SILC line card. This connectivity is supported for 1TR6, Numeris VN2, D70, EuroISDN, and Asia-Pacific protocols.

ISDN BRI TIE trunk connectivity is achieved through an MISP card and either S/T or U interfaces, using the SILC and UILC line cards respectively. For connectivity support, refer to Table 1.

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Table 1
ISDN BRI trunk connectivity support

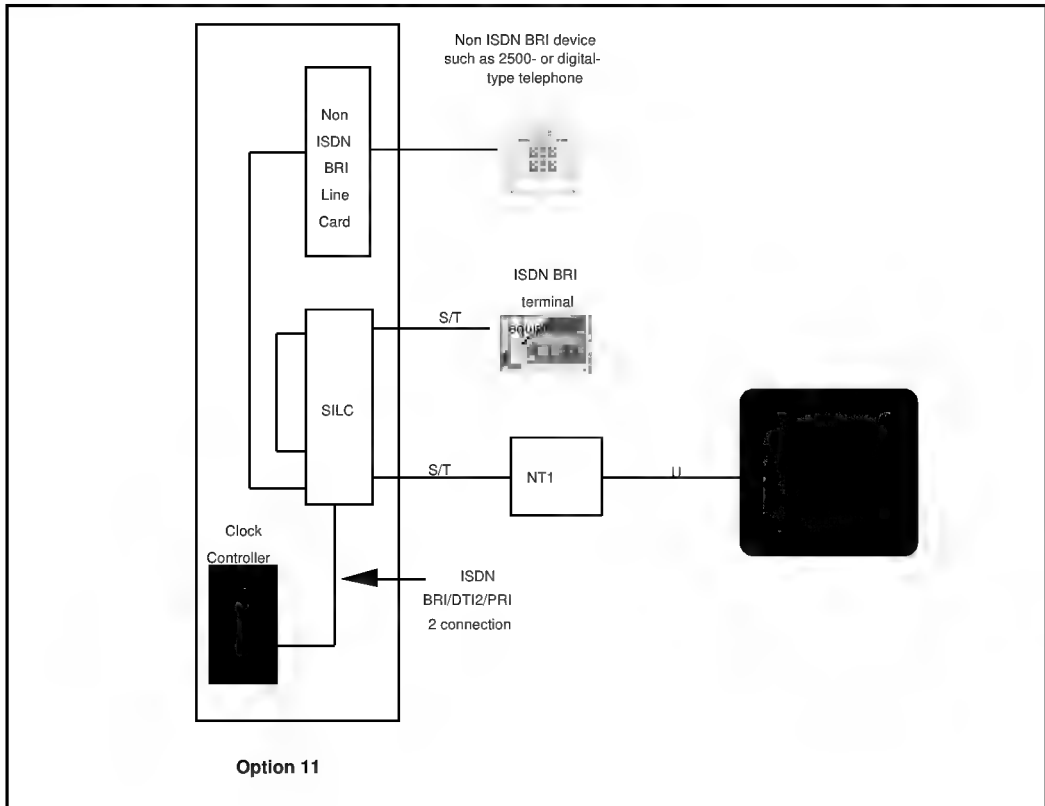
Trunk Connection	Where Supported
Local Exchange/DID connectivity (See Figure 7)	Supported for local exchanges that support any or all of 1TR6, Numeris VN2, D70, Asia Pacific, and EuroISDN protocols. Local exchange/DID connectivity is not supported in North America.
ISDN BRI TIE trunk connectivity through local exchange (See Figure 8)	Dependent on support from country specific local exchanges
ISDN BRI TIE trunk through NT1 (See Figure 9)	Supported between any two Meridian 1 systems (see Note)
ISDN BRI TIE trunk direct connection (See Figure 10)	Supported between any two Meridian 1 systems (see Note)
QSIG connectivity (peer-to-peer connectivity). (See Figure 11)	Supported between two Private Telecommunications Network Exchanges (PTNXs), between Centrex to Centrex, and between Centrex to PTNX, connected within a Private Telecommunications Network (PTN).
Note: In North America is possible only between two Option 11 systems. Contact your Northern Telecom representative for TIE trunk connectivity.	

ISDN BRI Local Exchange/DID connectivity

ISDN BRI Local Exchange connectivity is supported for 1TR6, Numeris, D70, EuroISDN, and Asia-Pacific protocols. This connection is accomplished through the SILC line card.

Figure 7 illustrates the ISDN BRI Local Exchange connectivity.

Figure 7
ISDN BRI trunk access local exchange connectivity



The ISDN BRI DSL is connected to a Network Termination (NT1) device, which is physically located on the same premises as the Option 11. The NT1 device connects to the Local Exchange that supports Numeris or 1TR6 protocol through a U interface. (The NT1 device is typically owned by the Local Exchange/Post Telegraph and Telephone allowing the Local Exchange/PTT to use any type of U interface, including proprietary implementations.)

The distance limitation of the NT1 from the Local Exchange depends on the distance supported by the Local Exchange.

Clock synchronization may be achieved by having the Option 11 slave to the local exchange; the clock source may be derived either from the ISDN BRI Local Exchange connection or from other PRI/DTI/ISDN BRI local exchange connections if available.

1TR6 local exchange connectivity

This facility provides 2B+D connectivity through an S/T interface to a local exchange that supports 1TR6 protocol through an S/T interface. The NT6D70BA SILC card provides the layer 1 interface, the MISP provides the layer 2 and layer 3 pre-processing interface, and the Option 11 software handles the layer 3 interface.

The ISDN BRI/1TR6 Local Exchange connectivity provides the following basic call and supplementary services:

Note: Support for any feature is dependent upon the terminal equipment being used.

- Basic call service
- CCircuit switched voice and data on the B Channel
- Calling Line Identification Presentation and Restriction (CLIP and CLIR)
- Connected Number Delivery
- support for COT, DID, DOD, and TIE trunk types
- Channel negotiation
- Overlap sending

- Flexible Numbering Plan
- Network-wide interworking with ISDN BRI 1TR6 terminals
- T0 (2B+D) to T2 (30B+D) backup

The protocol adapter does not provide hold/retrieve functionalities, due to 1TR6 protocol limitations. Therefore, when the user has a call waiting, the user must first release the active call before answering the waiting call.

The following services are supported for 1TR6 to 1TR6 calls, in a stand-alone or network environment:

- Telephone
- Telefax group 4
- Data transmission (64 kbps)
- Videotex (64 kbps)
- Teletex.

Numeris VN2 local exchange connectivity

Numeris is the ISDN protocol used in France and in any country that supports French protocol.

This implementation provides 2B+D connectivity through an S/T interface to a local exchange that supports Numeris protocol. The NT6D70BA SILC card provides the layer 1 interface, the MISP provides the layer 2 and layer 3 pre-processing interface, and the Meridian 1 software handles the layer 3 interface.

The ISDN BRI/Numeris local exchange connectivity provides the following basic call and supplementary services:

- Basic call service
- Circuit switched voice and data on the B Channel
- Called/calling party subaddress (network-wide)
- Support for COT, DID, DOD, and TIE trunk types
- Channel negotiation
- 64 kbps clear bearer capability

- Flexible Numbering Plan
- Advice of charge during call and at end of call
- Network-wide interworking with ISDN BRI Numeris terminals
- T0 (2B+D) to T2 (30B+D) backup

Japan D70 (INS NET-64) local exchange connectivity (non-Asia Pacific protocol)

The Japan D70 local exchange connectivity (non-Asia Pacific protocol) provides 2B+D connectivity through an S/T interface to a local exchange that supports the D70 protocol (D70 is the ISDN Japan protocol). The SILC card provides the layer 1 interface, the MISP provides the layer 2 and layer 3 pre-processing interface, and the Meridian 1 software handles the layer 3 interface.

The ISDN BRI/Japan D70 local exchange connectivity provides the following basic call and supplementary services:

- Basic call service
- Circuit switched voice and data on the B Channel
- Calling Line Identification (public and private)
- Support for COT, DID, DOD trunk types
- Channel negotiation
- 64 kbps clear bearer capability
- Flexible Numbering Plan
- Advice of charge at end of call (COT, DID, DOD, and TIE trunk call types)
- Channel Negotiation (applicable only at the DSL level. If a route includes several BRI trunks, and hence several DSLs, Channel Negotiation fails to yield an acceptable channel on a given DSL, and no attempt is made to obtain a channel on another DSL).
- T0 (2B+D) to T2 (30B+D) backup

EuroISDN connectivity

The EuroISDN connectivity provides an interface between Meridian 1 PBXs and Central Offices/Public Exchanges that comply to the European Telecom Standards Institute (ETSI) specification ETS 300 102 for the Layer 3. The interfaces provided by this feature also comply with the country-specific Application Documents for Austria, Denmark, Finland, Germany, Holland, Ireland, Italy, Norway, Portugal, Sweden, and Switzerland. Other countries must comply with ETS 300 102 to be supported.

The SILC card provides the layer 1 interface, the MISP provides the layer 2 functions and the layer 3 protocol control functions, and the Meridian 1 software handles the layer 3 interface.

The Meridian 1 on the EuroISDN connectivity provides the following call services, for the complying countries:

- Basic call service
- Circuit switched voice and data on the B Channel
- Calling Line Identification Presentation and Restriction (CLIP and CLIR)
- Connected Line Presentation and Restriction
- Support for COT, DID, DOD, and TIE trunk types
- Channel negotiation
- Overlap sending and receiving
- Flexible Numbering Plan
- T0 (2B+D) to T2 (30B+D) backup

Asia-Pacific connectivity

This Asia Pacific Connectivity provides interface between the Meridian 1 and Public Exchange/Central Offices in the following markets:

- Australia
- China
- Hong Kong
- Indonesia
- Japan
- Malaysia
- New Zealand
- Singapore
- Thailand

The following ISDN features are supported for the Asia Pacific connectivity:

- Basic Call Service
- Calling Line Identification Presentation and Restriction (CLIP and CLIR)
- Circuit switched voice and data on the B-channel (data calls are not supported on the Hong Kong interface)
- Overlap Sending (supported by all except Japan)
- Overlap Receiving (supported by the Indonesia, China, Malaysia, and Thailand interfaces only)
- COT, DID, DOD, and TIE trunk call types, as applicable
- 64 kbps unrestricted digital information
- Channel Negotiation

Note: in cases where several ISDN BRI trunks (and hence several DSLs) are configured on a route, if Channel Negotiation fails to yield an acceptable channel on any of these DSLs, it is not possible to use another channel on another DSL.

- Flexible Numbering Plan

- PRI Route Back-up with BRI routes, and
- Sub-addressing

The following supplementary services are supported for the Australia connectivity only:

- Malicious Call Trace
- Advice of Charge (AOC) at End of Call
- Incoming Trunk Programmable CLID for analog trunks. This feature is available for use in a private or alternative carrier network, as required in Australia.

The following supplementary services are supported for the Indonesia connectivity only:

- Connected Line Identification Presentation and Restriction (COLP and COLR)
- Direct Dialing Inward (DDI/DID)

The following supplementary service is supported for the Japan connectivity only:

- Advice of Charge (considered a basic service)

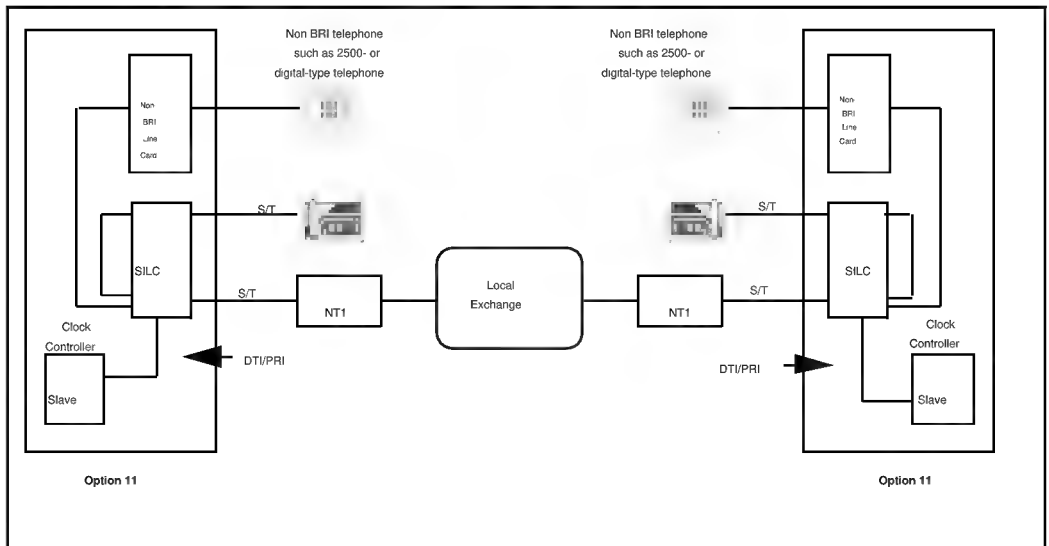
ISDN BRI trunk connectivity

ISDN BRI TIE trunk connectivity

ISDN BRI TIE trunk connectivity may have three implementations. In the first configuration (refer to Figure 8), a Meridian Customer Defined Networking (MCDN) TIE trunk connection may be implemented by connecting two Option 11s to the ISDN BRI leased line through the local exchange through two SILC cards. The S/T interface is connected to the local exchange using the NT1 supplied by the PTT.

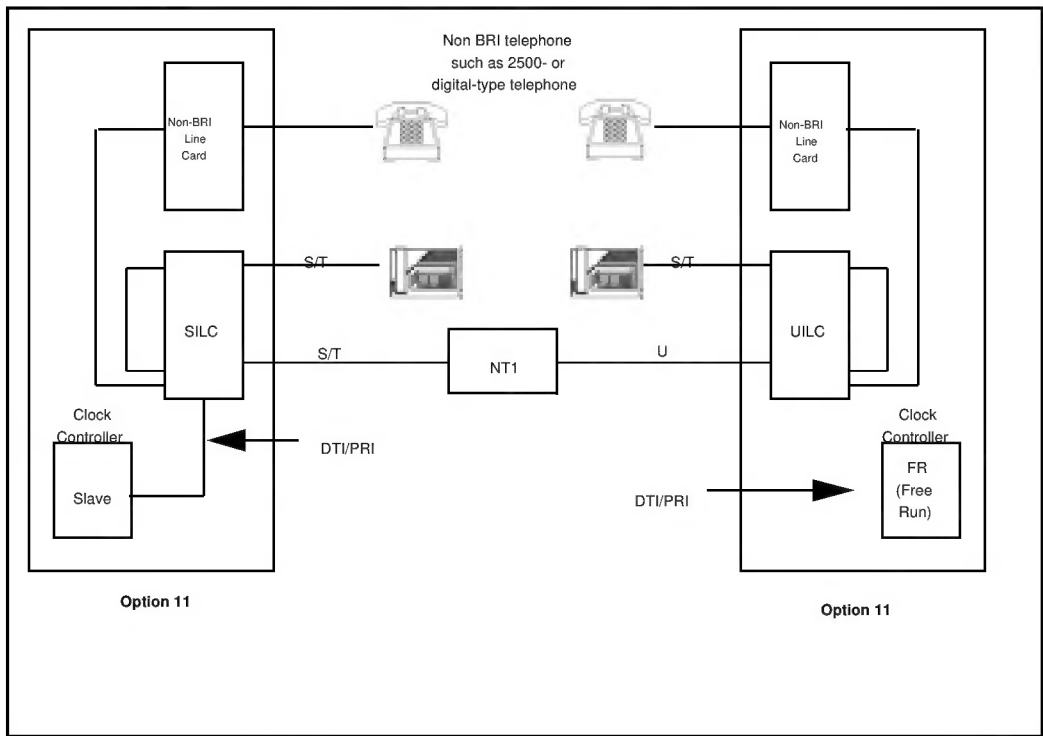
Clock synchronization may be achieved by having the Option 11 slave to the local exchange; the clock source may be derived either from any ISDN BRI local exchange connections or from other ISDN PRI/DTI local exchange connections if available.

Figure 8
ISDN BRI TIE trunk connectivity — first configuration



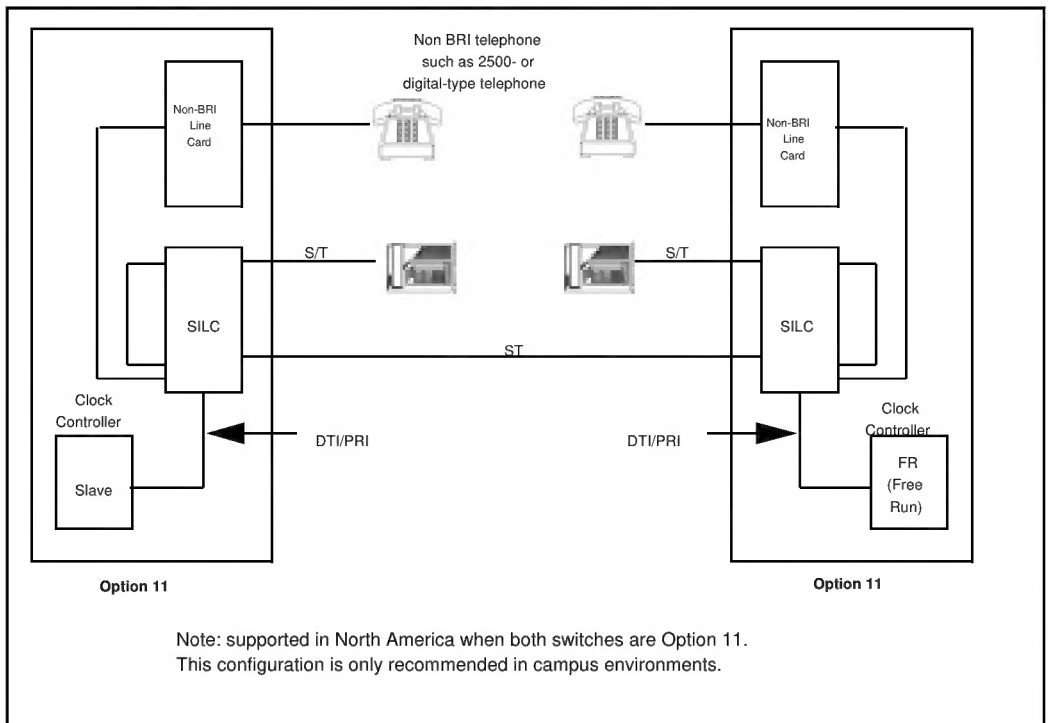
In the second configuration (refer to Figure 9), an MCDN TIE trunk connection may be achieved by connecting two Meridian 1s through an NT1 device. With this configuration, there is a distance limitation of 6.5 km (21325 ft), without any signal amplification device (such as a repeater). Clock synchronization may be achieved by having the Meridian 1 Option 11, equipped with the SILC, derive clock reference from the BRI TIE trunk connection or from other PRI/DTI/BRI connections if available. The Meridian 1 equipped with the UILC interface may be allowed to operate in free-run mode or derive the clock source from other PRI/DTI/BRI connections if available

Figure 9
ISDN BRI TIE trunk connectivity — second configuration



The third configuration (refer to Figure 10) establishes a MCDN TIE trunk link by connecting two Meridian 1s through a direct line between two back-to-back SILC interfaces. This configuration can be used in campus environments, although it is not recommended because of the lack of protection devices and because of the distance limitation of 1 km. Clock synchronization may be achieved by having one of the Meridian 1s derive clock reference from the BRI TIE trunk connection or from any other PRI/DTI/BRI connections if available. The other Meridian 1 may be allowed to operate in free-run mode or derive the clock source from any PRI/DTI/BRI connections if available.

Figure 10
ISDN BRI TIE trunk connectivity — third configuration



QSIG ISDN BRI trunk connectivity

The European Computer Manufacturer's Association (ECMA) has defined an ISDN protocol that specifies the Layer 3 signaling requirement for support of circuit switched call control at the "Q" reference point between Private Telecommunications Network Exchanges (PTNXs) connected within a Private Telecommunications Network (PTN). This protocol has been adopted by the European Telecommunications Standards Institute (ETSI) and the International Standards Institute (ISO). Most of the major European PTNX manufacturers will be supporting ISDN BRI (as well as PRI and ISL) connectivity based on this standard.

QSIG is oriented towards signaling and services that occur between peer-to-peer connectivity, that is, between two PBXs, between two Centrex PBXs, or between a PBX and a Centrex PBX; the signaling for services would be exchanged across a "Q" reference point.

For ISDN BRI, the QSIG interface will provide the following capabilities:

- Compliant Multi-vendor PBX/Centrex Private ISDN interworking (connectivity between the Private ISDN PBXs may be via PRI or ISDN BRI trunks)
- ETSI or ISO version of basic call service
- 64 kbps clear data
- Overlap Sending/Receiving
- Channel Negotiation
- Calling Line Identification Presentation (CLIP)
- Calling Line Identification Restriction (CLIR)
- Connected Line Identification Presentation (CLOP)
- Connected Line Identification Restriction (CLOR)
- Flexible Numbering Plan
- Support for TIE trunk call types
- Transit Count information transmitted when ISDN Call Connection Limitation (ICCL) is present (supported for ETSI QSIG only)
- Party Category (partially supported on ETSI QSIG)

Figure 11
QSIG ISDN BRI trunk connectivity

